	L #	Hits	Search Text	DBs	Time Stamp
1	L1	59	(((ruthenium or Ru) near4 (gas or precursor or reactant)) or ((ruthenium or Ru) near4 (gas$3 or precursor$3 or reactant$3))) same ((bis-cyclopentadienyl or bis-methylcyclopentadienyl or bis-ethylcyclopentadiencyl or tris-dipivaloylmethanate or (bis adj cyclopentadienyl) or (bis adj methylcyclopentadienyl) or (bis adj ethylcyclopentadiencyl) or (tris adj dipivaloylmethanate) or (Ru near2 ("CH.sub.3C.sub.5H.sub.4")) or (Ru near2 ("CH.sub.3C.sub.5H.sub.4")) or (Ru near2 ("C.sub.2H.sub.5C.sub.5H.sub.4")) or (Ru near2 ("C.sub.22H.sub.19O.sub.2")))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	2005/03/18 13:13
2	L2	1856	(ruthenium or Ru) near4 (gas$3 or precursor$3 or reactant$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	2005/03/18 13:13

	L #	Hits	Search Text	DBs	Time Stamp
3	L3	280168	"O.sub.2" or "N.sub.2O" or "H.sub.2O" or "NO.sub.2" or "O.sub.3"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	2005/03/18 13:13
4	L4	726	L3 and L2	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	2005/03/18 13:13
5	L5	490	L4 and ((@ad<"20010131") or (@rlad<"20010131"))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	2005/03/18 13:13

	L #	Hits	Search Text	DBs	Time Stamp
6	L6	36	(((((ruthenium or Ru) near4 (gas$3 or precursor$3 or reactant$3)) or ((bis-cyclopentadienyl or bis-methylcyclopentadienyl or bis-ethylcyclopentadiencyl or tris-dipivaloylmethanate or (bis adj cyclopentadienyl) or (bis adj methylcyclopentadienyl) or (bis adj ethylcyclopentadiencyl) or (tris adj dipivaloylmethanate) or (Ru near2 ("CH.sub.3C.sub.5H.sub.4")) or (Ru near2 ("CH.sub.3C.sub.5H.sub.4")) or (Ru near2 ("C.sub.2H.sub.5C.sub.5H.sub.4")) or (Ru near2 ("C.sub.22H.sub.19O.sub.2")))) same ("O.sub.2" or "N.sub.2O" or "H.sub.2O" or "NO.sub.2" or "O.sub.3")) and ((capacitor$3 or DRAM or (dynamic adj random adj access adj memory) or SDRAM))) and @py<="2001"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	2005/03/18 13:14

DOCUMENT-IDENTIFIER: US 20010054730 A1

TITLE: Metal-insulator-metal **capacitor** and manufacturing
method thereof

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Abstract Paragraph - ABTX (1):
A metal-insulator-metal (MIM) **capacitor** of a semiconductor device, and a manufacturing method thereof, includes a lower electrode formed of a refractory metal or a conductive compound including the refractory metal, a dielectric film formed of a high dielectric material, and an upper electrode formed of a platinum-family metal or a platinum-family metal oxide. Accordingly, the MIM **capacitor** satisfies the criteria of step coverage, electrical characteristics and manufacturing costs, as compared to a conventional MIM **capacitor** in which the upper and lower electrodes are formed of the same material such as a platinum-family metal, a refractory metal or a conductive compound including the refractory metal. The **capacitor** is especially suitable for mass production in semiconductor fabrication processes.

Pre-Grant Publication Year - PGPY (1):
2001

Title - TTL (1):
Metal-insulator-metal **capacitor** and manufacturing method thereof

Summary of Invention Paragraph - BSTX (3):
[0002] The present invention relates to a **capacitor** for a semiconductor device and a manufacturing method thereof, and more particularly, to a **capacitor** having a metal-insulator-metal structure (hereinafter, referred to as a MIM **capacitor**) and a manufacturing method thereof.

Summary of Invention Paragraph - BSTX (5):
[0004] As semiconductor technology evolves, the area occupied by

Detail Description Paragraph - DETX (22):

[0049] The Ru upper electrode 190 is formed by CVD or ALD at 250 to 450.degree. C. while an **Ru source gas obtained by vaporizing liquid Ru(C.sub.2H.sub.5C.sub.5H.sub.4).sub.2** and an **O.sub.2** reaction gas are being supplied. The surface morphology and electrical characteristics of the Ru film vary according to the conditions for deposition. As disclosed in Korean Patent Application No. 99-61337 filed on Dec. 23, 1999 by the present applicant and incorporated herein by reference, the Ru upper electrode 190 having a desired property can be obtained by varying the deposition conditions over the early and late stages of deposition. In this case, to be more specific, at the early stage of deposition, ruthenium deposited for a time period ranging from 5 seconds to 5 minutes in a state where the pressure within the reaction chamber is maintained at 10 to 50 Torr, more preferably, at 20 to 40 Torr, and the flow of an **O.sub.2** gas is maintained at 500 to 2000 sccm, more preferably, at 1000 to 1500 sccm. At the late stage of deposition, ruthenium is deposited until an Ru film having a desired thickness is formed, by maintaining the pressure within a reaction chamber at 0.05 to 10 Torr, more preferably, at 0.1 to 3 Torr, and maintaining the flow of an **O.sub.2** gas at 10 to 300 sccm, more preferably, at 50 to 150 sccm.

Detail Description Paragraph - DETX (23):

[0050] In the modified embodiment of the present invention, as shown in FIG. 9, a Si.sub.3N.sub.4 reaction prevention film 200 can be sandwiched between the lower electrode 162 and the dielectric film 180. In this embodiment, the silicon nitride film 200 is formed on the entire surface of the substrate of FIG. 7 on which the cylindrical TiN lower electrode 162 is formed, by CVD using a Si source gas such as a silane-family gas and an N source gas such as NH.sub.3. Next, the dielectric film 180 and the upper electrode 190

are formed
on the resultant structure, thereby forming a **capacitor** according to this
embodiment of the present invention. Here, preferably, the Si.sub.3N.sub.4
reaction prevention film 200 is deposited to be in an amorphous state at 600 to
700.degree. C., and the dielectric film 180 is thermally treated and
crystallized after the upper electrode 190 is formed. If the crystallization
of the Ta.sub.2O.sub.5 dielectric film 180 is performed before the Ru upper
electrode 190 is formed, the Si.sub.3N.sub.4 reaction prevention film 200
operates as a crystallization seed layer of the Ta.sub.2O.sub.5 dielectric film
180, so that the dielectric constant of the Ta.sub.2O.sub.5 dielectric film 180
slightly increases. In contrast, when the crystallization of the
Ta.sub.2O.sub.5 dielectric film 180 is performed after the Ru upper electrode
190 is formed, the Ru upper electrode 190 operates as a crystallization seed
layer of the Ta.sub.2O.sub.5 dielectric film 180, so that the dielectric
constant of the Ta.sub.2O.sub.5 dielectric film 180 increases substantially.

Detail Description Paragraph - DETX (24):

[0051] FIGS. 10 and 11 are graphs showing the accumulative distributions
according to the electrical characteristics of a **capacitor** according to the
embodiment of the present invention. In these experiments, a cylindrical
capacitor having a CVD-Ru upper electrode/CVD-Ta.sub.2O.sub.5 dielectric
film/CVD-TiN lower electrode structure is used, the height of the lower
electrode is set to be about 1 .mu.m, and the thickness of the dielectric film
is set to be about 150 .ANG..

Detail Description Paragraph - DETX (25):

[0052] Referring to FIG. 10, the capacitance of a **capacitor** according to the
embodiment of the present invention is about 40 fF per cell, and the ratio of
C.sub.min/C.sub.max is about 0.99. Referring to FIG. 11, when .+-.1 voltage

was applied, a good leakage current density, about 10.sup.-16 A per cell, was
measured.

Detail Description Paragraph - DETX (26):
[0053] In the above-described embodiments, upper and lower electrodes and a
dielectric film are formed by depositing a particular material using a
particular method. However, if a source gas is appropriately selected, other
materials mentioned above can be used. In cases of **capacitors** not having a
three-dimensional shape such as a cylindrical shape, it is apparent that the
upper and lower electrodes and the dielectric film can be formed by other
methods such as sputtering.

Detail Description Paragraph - DETX (27):
[0054] As described above, in **capacitors** using a high dielectric material to
form a dielectric film, according to the present invention, a lower electrode
is formed of a refractory metal or a conductive compound containing the
refractory metal, the deposition and etching of which are put into practical
use, so that a three-dimensional lower electrode can be formed with excellent
step coverage. Also, an upper electrode is formed of a platinum-family metal
or a platinum-family metal oxide, so that a **capacitor** having superior
electrical characteristics can be obtained.

Detail Description Paragraph - DETX (28):
[0055] Also, an MIM **capacitor** according to the present invention satisfies
the step coverage, the electrical characteristics and manufacturing costs,
compared to a conventional MIM **capacitor** in which the upper and lower
electrodes are formed of the same material such as a platinum-family metal, a
refractory metal or a conductive compound including the refractory metal. In
particular, by developing and applying a new CVD method to deposit a
platinum-family metal such as Ru, which heretofore has had no practical
deposition methods, the electrical characteristics of a **capacitor** can be

guaranteed. Accordingly, the **capacitors** according to the present invention can
be mass-produced.

Claims Text - CLTX (2):
1. A **capacitor** comprising: a lower electrode formed of a refractory metal
or a conductive compound including the refractory metal; a dielectric film
formed of a high dielectric material on the lower electrode; and an upper
electrode formed of a platinum-family metal or a platinum-family metal oxide on
the dielectric film.

Claims Text - CLTX (3):
2. The **capacitor** of claim 1, wherein the refractory metal is one selected
from the group consisting of Ti, Ta and W, and the conductive compound
including the refractory metal is one selected from the group consisting of
TiN, TiSiN, TiAlN, TaN, TaSiN, TaAlN and WN.

Claims Text - CLTX (4):
3. The **capacitor** of claim 1, wherein the dielectric film is a single film
or a composite film, and is formed of at least one material selected from the
group consisting of Ta.sub.2O.sub.5, Al.sub.2O.sub.3 and TaON.

Claims Text - CLTX (5):
4. The **capacitor** of claim 1, wherein the platinum-family metal is one
selected from the group consisting of Ru, Pt and Ir, and the platinum-family
metal oxide is one selected from the group consisting of RuO.sub.2, PtO and
IrO.sub.2.

Claims Text - CLTX (6):
5. The **capacitor** of claim 1, further comprising a reaction prevention film
between the lower electrode and the dielectric film to prevent the reaction
between the material of the lower electrode and that of the dielectric film.

Claims Text - CLTX (7):
6. The **capacitor** of claim 5, wherein the reaction prevention film

is formed
of a material selected from the group consisting of Si.sub.3N.sub.4, Al.sub.2O.sub.3, TaON, HfO.sub.2 and ZrO.sub.2.

Claims Text - CLTX (8):
7. A **capacitor** comprising: a cylindrical lower electrode formed of TiN; a
dielectric film formed of Ta.sub.2O.sub.5 on the lower electrode; and an upper
electrode formed of CVD-Ru on the dielectric film.

Claims Text - CLTX (9):
8. The **capacitor** of claim 7, further comprising a Si.sub.3N.sub.4 reaction
prevention film between the lower electrode and the dielectric film to prevent
the reaction between the material of the lower electrode and that of the
dielectric film.

Claims Text - CLTX (10):
9. A method of manufacturing a **capacitor**, comprising: forming a lower
electrode of a refractory metal or a conductive compound including the
refractory metal on a substrate; forming a dielectric film of a high dielectric material on the lower electrode; and forming an upper electrode of
a platinum-family metal or a platinum-family metal oxide on the dielectric
film.

Claims Text - CLTX (16):
15. The method of claim 9, further comprising thermally treating the
capacitor, after the step of forming an upper electrode.

Claims Text - CLTX (21):
20. A method of manufacturing a **capacitor**, comprising: forming a cylindrical lower electrode by chemical vapor depositing TiN on a substrate;
forming a dielectric film of Ta.sub.2O.sub.5 on the lower electrode; and
forming an upper electrode by chemical vapor depositing Ru on the dielectric
film.

Claims Text - CLTX (23):
22. The method of claim 20, further comprising thermally treating the

capacitor, after the step of forming an upper electrode.